



TUBES

HAM NEWS

JANUARY-FEBRUARY, 1961

THE OMNIVOX

THE OMNIVOX is a feature packed simple, flexible audio preamp/vox/transmitter control and phone patch unit. Integrated into this design project are the following author's dozen features:

1. 6BN6 gated beam VOX tube for positive anti-trip.
2. Automatic Level Control (ALC) of audio amplifier for uniform modulation from microphone and telephone inputs.
3. Hybrid phone patch with 6AL7-GT twin indicator tube to monitor voltage into line and ALC operation.
4. Individual phone and master gain controls.
5. Adjustable VOX Sensitivity, anti-trip and holding time controls.
6. Manual or automatic VOX control.
7. Shaped audio band-pass from 250-3000 cps.
8. Visual indication of ALC bus voltage.
9. Visual indication of "zero-beat" for on-the-nose net operation.
10. Peak compression circuit.
11. Zero audio output until control relay operates.
12. Speaker output attenuated automatically in "Patch On" position.
13. Auxiliary audio output position (with attenuated speaker output) for recorder or oscilloscope.

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W4PFQ MONITORS PHONE PATCH being handled through the OMNIVOX (just below receiver) installed in his station. Operating console also includes transmitter exciter (next to receiver), and — on lower level — speaker, power control panel (center) and audio system for transmitter. Large cabinet at left houses a final amplifier with pair of 6L-813's, plate modulator and power supplies. W4PFQ operates principally on double sideband.



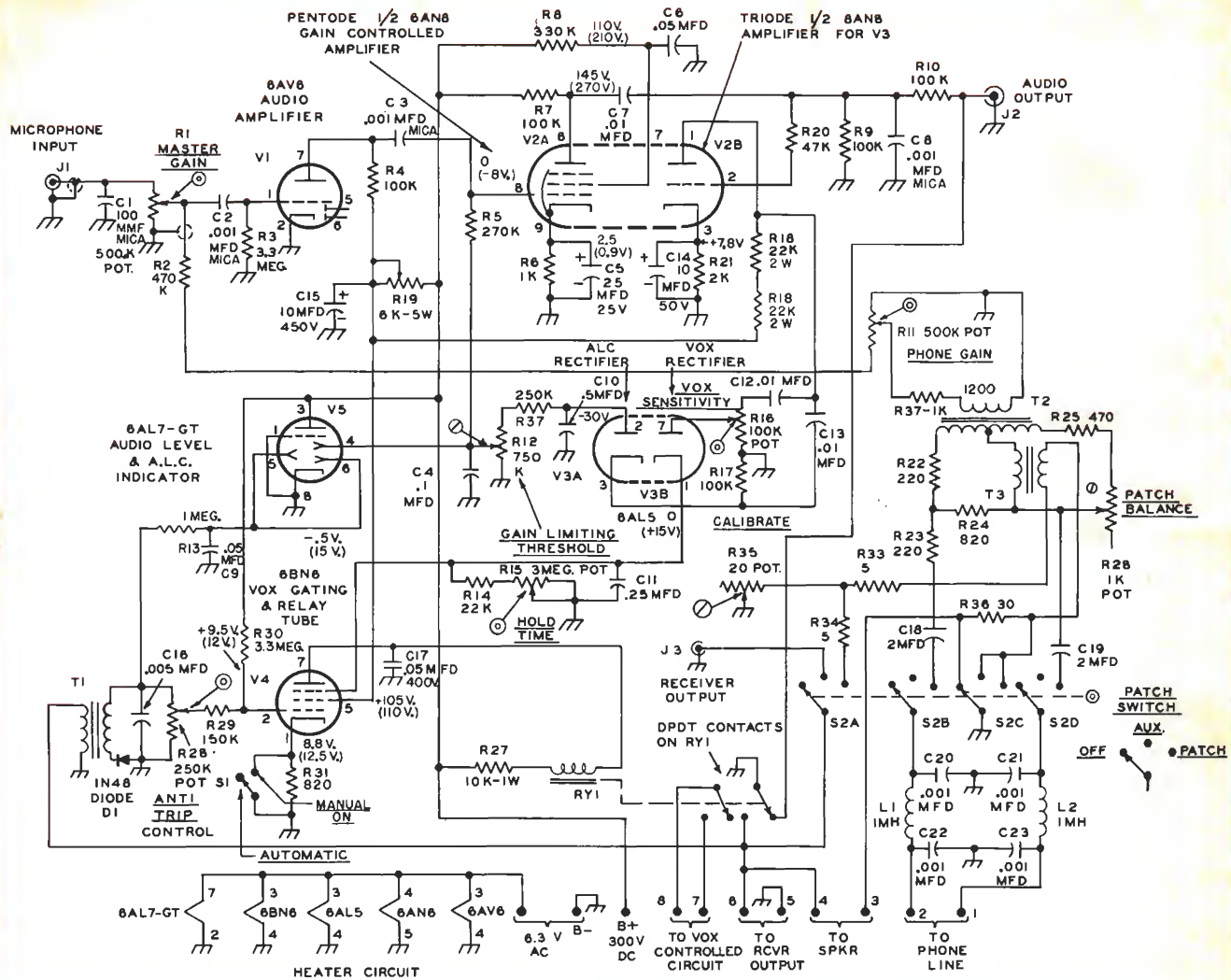
CLOSE-UP VIEW of the OMNIVOX centered on a 3½ x 19-inch rack panel. Switch, fuse and pilot light at left control external power supply for the OMNIVOX.

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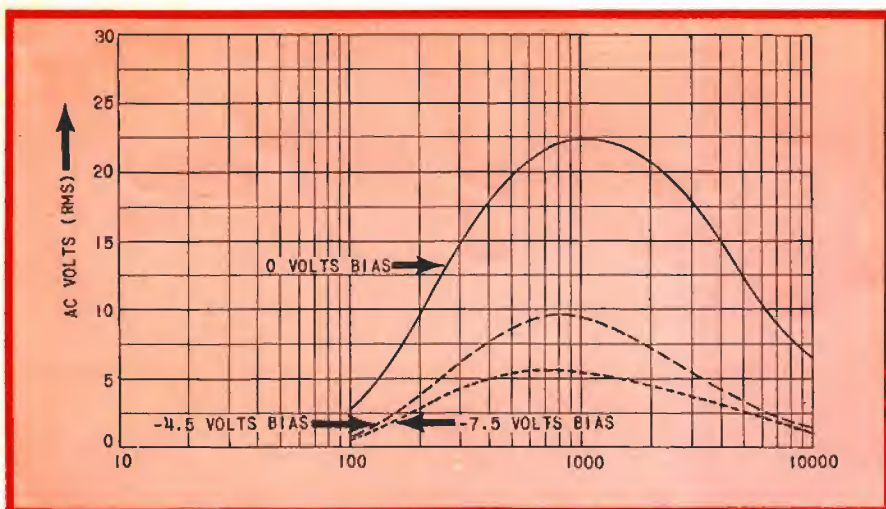


FIG. 3. AUDIO FREQUENCY response characteristic of the preamplifier. Curves show change in output level at constant input level with different values of ALC bias. When converted to decibel scale and normalized, all three curves nearly coincide. This indicates that the bandpass remains constant over wide gain variations.

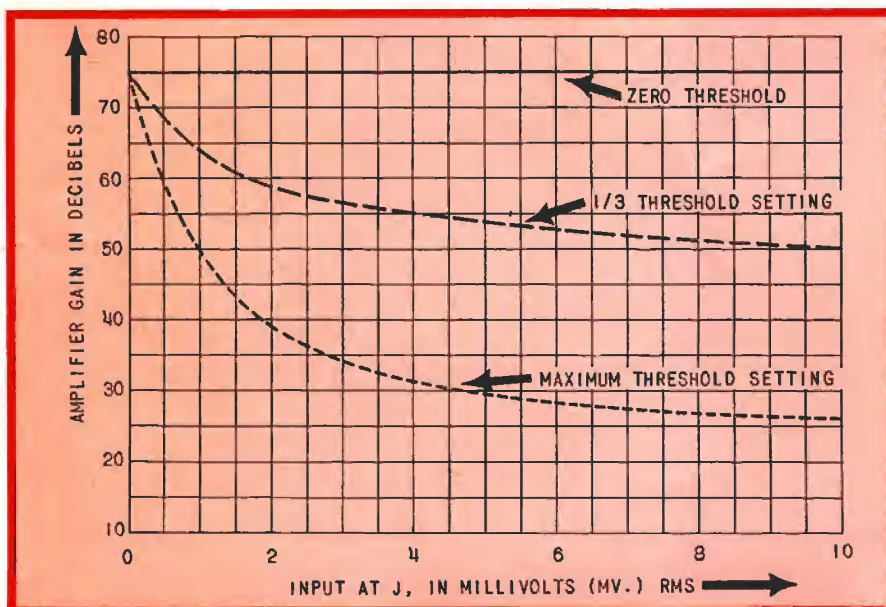


FIG. 4. GRAPH SHOWING range of control provided by ALC system over range of zero threshold voltage, to full threshold voltage.

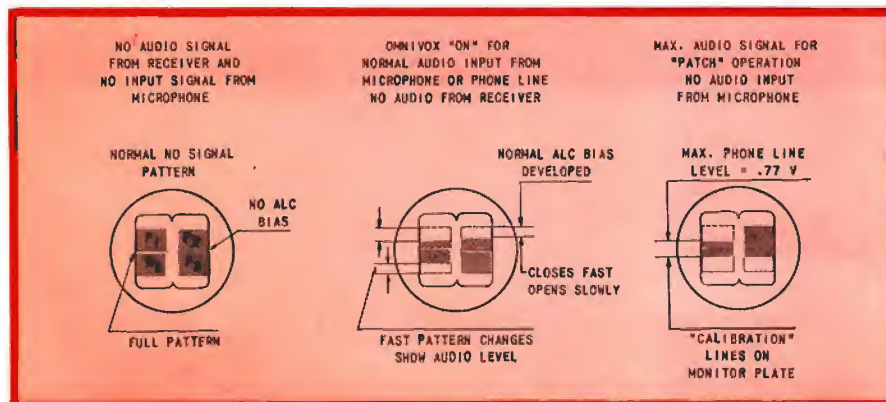


FIG. 5. PATTERN SHOWN on 6AL7-GT indicator tube (V_5) with (left) no audio signal; (middle) audio signal compressed normal amount, with left hand pattern changing at syllabic rate, and right hand pattern changing at slow rate with variations in ALC bias. Maximum phone line level of 0.77 volt is shown in pattern view at right.

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small output transformer operated backwards), where it is stepped up and rectified by a 1N48 diode (D_1). The voltage developed across C_{16} and R_{28} provides negative going pulses of voltage which are superimposed on the positive DC voltage on the No. 1 grid of V_1 by adjusting the Anti-Trip control (R_{28}). An additional RC filter (R_{17} and C_9) provides a DC voltage to the deflection electrodes of V_2 which is proportional to the peak audio voltage delivered by the station receiver to the OMNIVOX. Thus the pattern of three sections of V_2 compresses as more audio voltage is fed from the receiver, as shown in Fig. 5.

HEART OF THE CONTROL SECTION

of OMNIVOX is the 6BN6 gated beam tube (V_4). This tube is constructed in such a way that its plate receives current only when both of the grids are cut on. Thus an anti-trip voltage at the No. 1 grid can cut off the beam and, regardless of the amount of positive voltage on the second control grid, the plate cannot draw current. By this means, anti-trip action is not a matter of delicate balance between opposing voltages.

The 6BN6 (V_4) operates with nearly constant cathode current, developing 9.5 volts across R_{31} , and providing cut-off voltage for the second control grid. The first grid is connected to a voltage divider made up of R_{30} , R_{29} and R_{28} from plus 300 volts to ground, and is clamped at zero bias. Thus, in the absence of anti-trip voltage derived from receiver output, the input gate is open.

Since the second grid is cut off, no plate current flows until audio voltage applied to V_{3B} develops a positive gating bias at the 6BN6's second grid. This starts plate current flow in the 6BN6, causing R_{31} to close. Its DPDT contacts unground the audio output signal from V_{2A} , mute the speaker and close the external VOX control circuit on terminals 7 and 8.

The gating bias remains on the second control grid of V_4 as long as there is sufficient positive voltage across C_{11} . The HOLD control (R_{15}) adjusts the discharge time of C_{11} . Space charge effects in V_4 further modify the discharge characteristics so that the components specified give a range of Hold from milliseconds to continuously on. In the Manual position of S_1 , the cutoff bias for the second gating grid is removed and closes R_{31} .

THE PHONE PATCH SECTION of OMNIVOX is a hybrid circuit made up of a pair of transformers, a balancing network, cou-

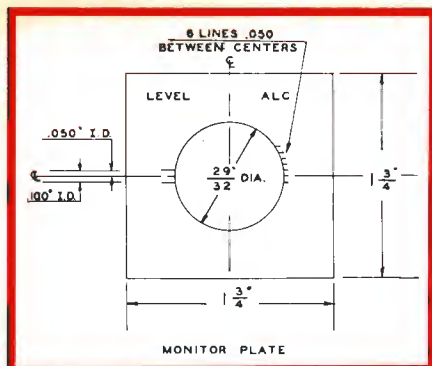


FIG. 6. DIMENSIONAL DIAGRAM of the escutcheon plate for the 6AL7-GT (V_5) indicator eye tube. Calibration marks at left are for maximum phone line level of 0.77 volt. Material used is $\frac{1}{8}$ -inch thick black bakelite.

pling capacitors and a pi-section RF filter for the phone extension line. In the *OFF* position of S_2 , the patch is off and is completely out of the circuit (with the exception of the RF filter which is left in at all times). In the *AUX.* position of S_2 , the receiver output is switched to the *Receiver Output* jack (J_3). Simultaneously a 30 ohm resistor is connected in series with the speaker voice coil to attenuate the audio output about 10 decibels.

In the *PATCH* position of S_2 , the hybrid transformers are connected to the telephone line through low-leakage paper coupling capacitors (C_{15} and C_{16}). In addition, while the speaker remains attenuated, a *Tee* network is connected between the receiver output and the primary of T_3 , which couples audio from the receiver to the telephone line.

Earlier, it was explained that the 6AL7 (V_5) was driven by a negative voltage proportional to the peak receiver output voltage. In the *PATCH-ON* position of S_2 , R_{25} (in the *Tee* network) can be adjusted so that the maximum audio voltage supplied to the 'phone line is equal to the maximum allowable line voltage (usually about 0.77 volts) for a specific amount of pattern compression on V_5 . The escutcheon plate shown in Fig. 6 is marked for this purpose. Once this calibration has been accomplished, the 6AL7-GT eye tube monitor provides a direct means for checking the audio level to the line. This makes it possible for the operator to adjust the station receiver audio output to the proper patch operating level.

The *Balance* control (R_{26}) is used to adjust the current flow through the two sections of the primary of T_2 due to the presence of voltage across the secondary of T_2 , so that receiver output is not coupled through T_2 to the audio amplifier

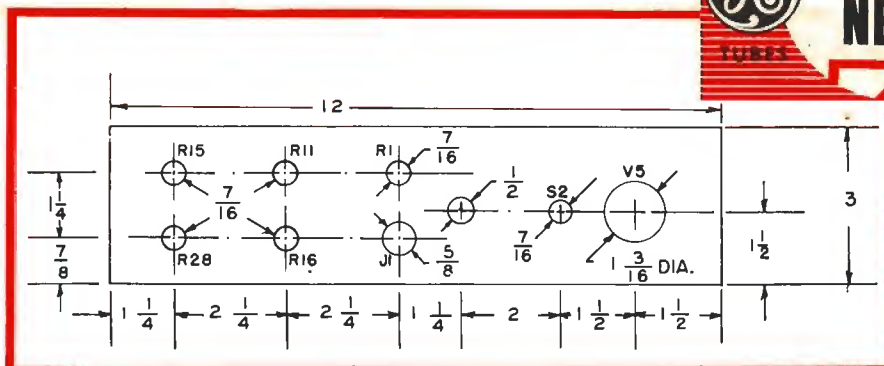


FIG. 7. DRILLING DIAGRAM for the chassis and front panel of the OMNIVOX. Dimensions can be changed to suit individual layout needs, but should follow the same pattern. Small holes for mounting hardware are not shown.

section of OMNIVOX. To adjust R_{26} , the patch is switched on (after you have dialed an understanding friend on the land line) and the *Phone Gain* control (R_{11}) is opened to impress voltage from the secondary of T_2 on V_5 . Receiver output is being fed into T_3 in this case and the circuit may tend to oscillate unless the *Sensitivity* control (R_{16}) is at minimum gain.

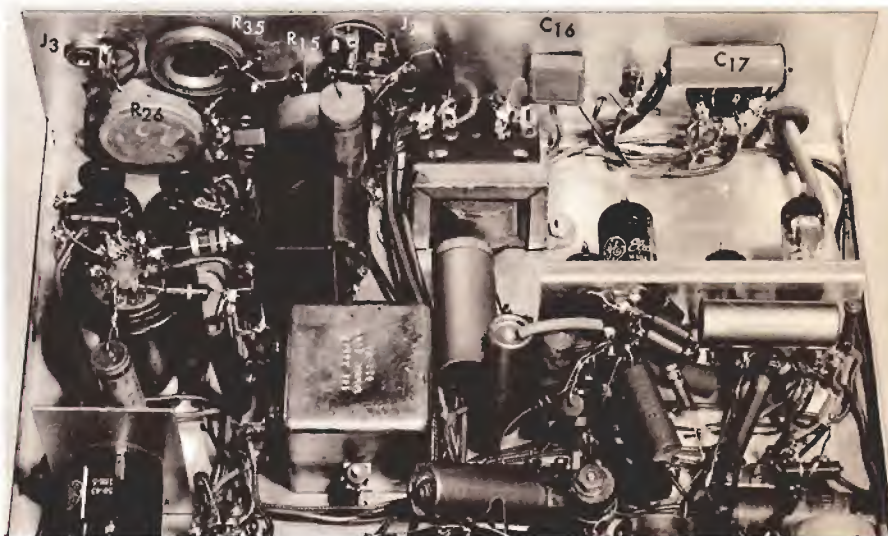
With the *Threshold* control (R_{12}) about mid-point, the *Patch Balance* control (R_{26}) may be adjusted slowly until the ALC monitoring section of V_5 , indicating the amount of audio voltage out of V_{5A} , shows zero output voltage. The *Master Gain* control (R_1) may be opened further to increase the system gain for more precise balance. Although this adjustment is quite sensitive, the visual indication provided by V_5 makes this a simple operation. Following the balancing of the hybrid circuit,

the calibration of phone line voltage versus V_5 pattern compression should be rechecked.

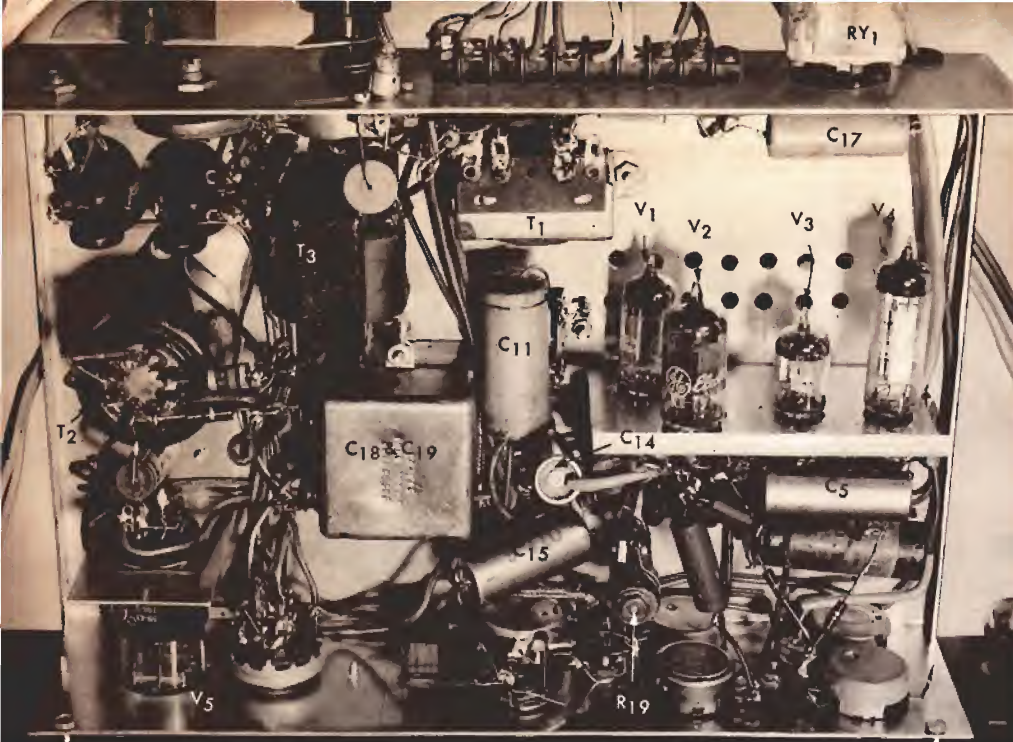
The OMNIVOX may now be operated from the phone line by adjusting the *Master Gain*, *Phone Gain* (R_{11}), and *Sensitivity* controls (R_{16}) appropriately. Slight compression of gain by ALC action from the voice input on the line should be indicated by V_5 . When the microphone in the telephone is providing the audio signal, the ALC will reduce the gain of V_{5A} (depending on the setting of the *Threshold* control) so that the audio output is not excessive even though the output from the handset is many times greater than the usual 'phone line signal.

Note that the reduced speaker output in the *Patch-ON* position of S_2 helps prevent audio feedback from speaker to the telephone microphone. Changing S_2 from "*Patch-ON*" to

(continued on page 6)



INSIDE VIEW of the OMNIVOX built in an 8 x 12 x 3-inch deep chassis box, looking toward rear side. Locations of major parts should follow the same general layout. Point-to-point wiring method was used, with terminal strips supporting clusters of small components near sub-chassis at right, and phone patch section at left.



BEHIND-PANEL DETAILS are shown in this view. A small bracket made from $\frac{1}{16}$ -inch thick sheet aluminum supports the socket for the 6AL7-GT indicator eye tube at left. The phone line isolating capacitors (C18 and C19) are stacked and fastened with long machine screws at center of chassis.

OMNIVOX (continued from page 5)

"Aux." provides an immediate disconnect between the phone line and the patch circuit without a blast from the speaker. When running a phone patch through the OMNIVOX, the positive gating action of the VOX control tube and the easy shift from automatic to manual control, provide sufficient flexibility to meet the variety of operating conditions and degree of familiarity with patch procedures likely to be encountered.

The 6AL7-GT monitoring indicator is also useful for frequency checking and zero-beating to net or roundtable frequencies. Since the indicator is DC-coupled to the 1N48 anti-trip diode, and the time constant of the filter is relatively short, the compressed pattern opens abruptly as zero-beat is approached

between the received signal and the beating signal from a transmitter VFO, crystal calibrator, or inter-polarization oscillator.

It is possible to see the beat note down to about 2 cps with this system (this is usually close enough for most tuning). In order to use this feature on SSB it may be necessary to insert some carrier while setting the transmitter on frequency. For DSB (used by the author), or for AM, carrier is readily available at the operating frequency.

CONSTRUCTION of the author's model OMNIVOX was accomplished in an 8 x 12 x 3-inch chassis.

The pictures of the completed unit on pages 2, 5 and 6 show most of the pertinent constructional details. A smaller chassis size could be used if smaller parts than those from the author's junk box are available.

Controls which may be used during normal operation were mounted on the front side of the chassis in the locations shown in the drilling diagram, Fig. 7. The four control tubes (V1 to V4) were mounted internally on a small sub-chassis bracket running parallel to the front panel. Fabrication details of this bracket are shown in Fig. 8. The 6AL7-GT indicator tube (V5) is mounted on another bracket made from $\frac{1}{16}$ -inch thick sheet aluminum, located so that the tube protrudes through the 1 $\frac{1}{8}$ -inch diameter hole in the chassis front (and panel, too).

An 8-terminal barrier strip for external signal connections, the Gain Limiting Threshold (R12), Patch

Balance (R20) and Calibrate (R25) controls, the Receiver Output (J1) and Audio Output (J2) jacks, and control relay (R11), are mounted on the rear side of the chassis. Power for the heater and plate power come in on a 4-wire cable.

Almost all wiring is run with insulated hookup wire. Leads from J1 to R1, R1 to the control grid of V1, and to the Phone Gain control (R11) are run with shielded single conductor wire. Small parts are mounted on lugs of components they connect with, and on terminal strips.

TESTING THE OMNIVOX, when completed consists of connecting it to a power supply furnishing 300 volts DC at 40 milliamperes, and 6.3 volts at 2 amperes. The audio section should be checked out first, and then bias voltage measurements in the ALC circuit are taken to check its operation.

The VOX circuit should then be tested, and calibration of the indicator eye tube is completed. Instructions for adjusting the various controls have been given heretofore in the description of the OMNIVOX circuits, and will not be repeated here. Balancing and testing of the Phone Patch circuit should be done last after the other adjustments have been completed.

Finally the chassis cover plate is installed with self-tapping screws, and the OMNIVOX is installed in the position it will occupy in the station. The package has been designed so that it can set under, or on top of, a receiver, speech amplifier, etc. Or, it can be stood on end between units on the operating desk. If the latter position is chosen, vent holes should be drilled in the chassis sides which form the bottom and top. Small rubber feet also should be secured to the bottom side.

Operation of OMNIVOX is pretty much automatic once the Microphone Gain, Telephone Gain, and VOX Sensitivity controls have been set. The Anti-Trip control should be adjusted so that speaker noise does not actuate the VOX circuit. The Hold Time control should be set to individual tastes, with sufficient hold in time so that R12 remains closed between spoken sentences.

Portions of the OMNIVOX circuitry may easily be adapted to existing transmitter audio equipment, if desired. The audio gain-controlled amplifier, with its speech frequency range emphasis, and the VOX circuits too, are superior to similar circuits found in some commercial transmitters.

Improve your amateur station by incorporating the complete OMNIVOX, or portions of the circuit, into your equipment.

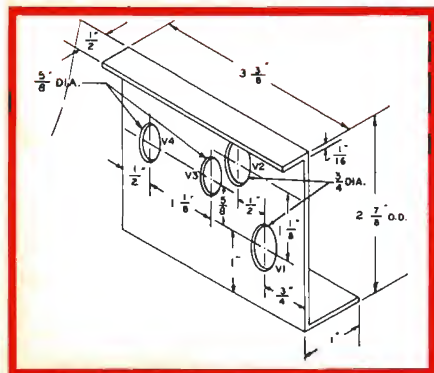


FIG. 8. LAYOUT DIAGRAM for the sub-chassis on which the four miniature tubes are mounted. A sheet of $\frac{1}{16}$ -inch thick aluminum $4\frac{1}{2} \times 3\frac{3}{8}$ inches is required.

VERSATILE POWER-CONTROL BOX

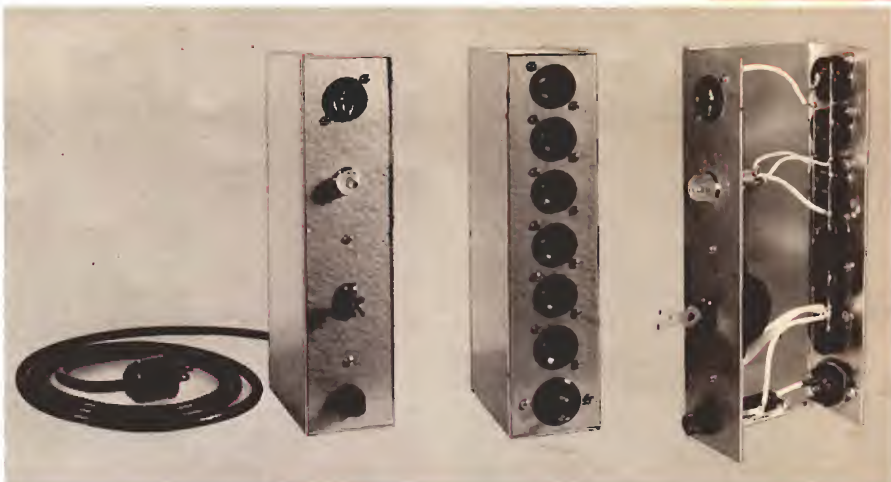
By Philip E. Hatfield, W9GFS

Few amateur stations today have equipment permanently wired to power lines through disconnect switches; rather, the trend toward tabletop units with simple power cord connections has sometimes brought about a tangle of extension cords and cube taps, necessary to connect a receiver, moderate power transmitter, and accessory equipment to the power line.

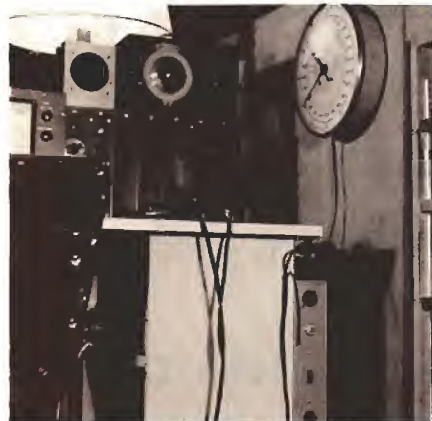
A useful accessory to lessen the power-line haywire may be easily constructed in the form of an AC outlet box — shown in the accompanying illustrations. The mechanical design can be tailored to fit individual installations. The box shown in use at W9GFS was intended for mounting on the side of a desk. A different layout would permit other mounting positions.

THE SCHEMATIC DIAGRAM, Fig. 1, shows the outlets split into groups: (1) those that remain on as long as the box is plugged in, intended for a desk lamp and clock; and (2) those controlled by a main switch (S_1) and intended for the receiver, transmitter, and accessories. A fuse is included in the circuit for all of the outlets.

The input plug and all of the outlets but one are mounted on the rear of the box, since constant accessibil-



POWER CONTROL BOX constructed by W9GFS, showing (left to right) front, rear and inside views. Note tinned copper wire connections between outlet receptacles.



INSTALLATION of power control box at W9GFS fastened to the side of operating console.

ity is not necessary. One outlet in the group not controlled by the switch is mounted on the front to allow ready accessibility for a soldering gun. The neon lamp on the front of the box indicates when the switched group of outlets are on.

The switch allows all station units to be turned on or off without the use of the switches on the individual units. The switch on the model shown requires a key to turn it on;

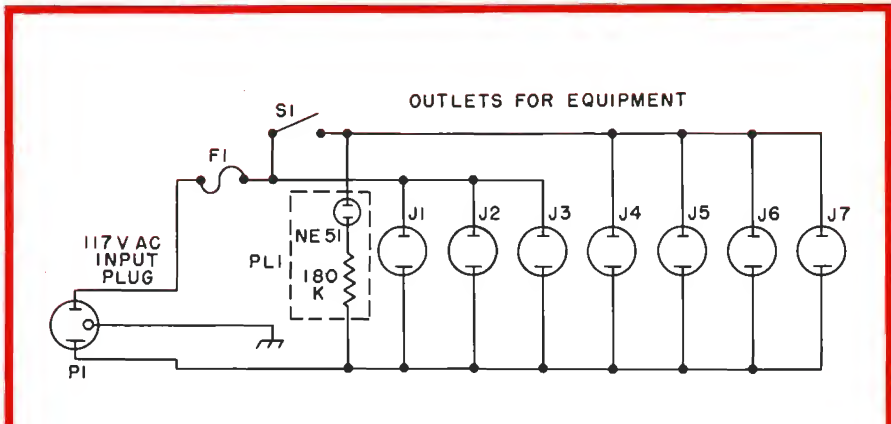


FIG. 1. SCHEMATIC DIAGRAM of the power control box. Wiring should be run with No. 14 or No. 12 wire. The three outlets at left (J_1 , J_2 , and J_3) have power on them continuously. Polarized receptacles and plugs may be used if available.

TABLE I — PARTS LIST — POWER CONTROL BOX

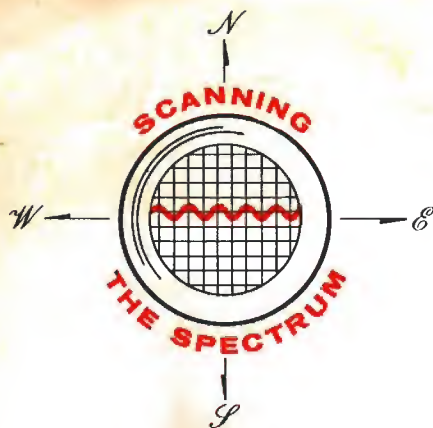
F_1Fuse holder for 3AG fuse, and fuse rated at 5 or 10 amperes, depending on load drawn from box.	PL_1Panel lamp assembly with dropping resistor for NE-51 Neon lamp.
J_1 to J_72-prong female power receptacles for chassis mounting (Amphenol 61-MIP-61F)	S_1Lock type flush tumbler switch (Bryant 5861-L, or equivalent).
P_12-prong male power connector for chassis mounting (Amphenol 61-MIP-1)	Box...LMB No. 144 box chassis 10 x 4 x 2½ inches.

this prevents children from energizing the equipment. A conventional wall-switch which has the same dimensions may be substituted.

All of the outlets used are of the polarized type, and care should be taken in connecting the plugs on the attachment cord to preserve the polarity relationship. If the box will be used within reach of a ground, a 3-wire safety type plug should be used to ground the box.

This control box usually will handle transmitters rated at up to 200 watts input. Higher power transmitters, especially those in the kilowatt class, should be powered from a separate circuit. However, all station equipment except a large transmitter can be controlled by the power control box.

Devote one or two evenings to eliminating your line cord haywire by constructing this handy box.



**A New Feature —
MEET OUR AMATEUR
TUBE DISTRIBUTORS —**



Uncle Dave Marks, W2APF (center), visited the amateur radio station at Vatican City, HV1CN, on a trip to Europe recently. At left is Dr. Loris Castaldi, I1CL, who acted as interpreter and, at right, Domenico Petti, Chief Operator and Custodian of HV1CN.

W2APF is widely known as the operator of UNCLEDAVE'S Radio Shack in Albany, New York. During several foreign and globe-girdling tours, Dave has met thousands of radio amateurs, and may well have set a record for this feat.



CAPACITORS FOR HAMS — General Electric's new line of "application rated" Service-Designed Alumatytic® capacitors will replace more than 1,200 different types with only 275 twist-prong and tubular types. Amateurs will find them ideal for replacement, or for new home-built equipment. Ask for them at your G-E Tube distributor's.

MEET OUR AUTHORS —

W9GFS — Philip E. Hatfield, found a solution to the usual tangle of power cords and cube taps in the neat power control box for his station described on page 7.

Phil's previous contributions to **G-E HAM NEWS** have been the **GADGET RACK** and accessories in the September-October, 1958 issue, and "OPERATING G-E HI-FI TUBES AS MODULATORS" in the January-February, 1960 issue.

Vocationally, W9GFS is a technical data engineer with G.E.'s Receiving Tube Department here in Owensboro. He has authorized several articles for *QST*, *Electronics World*, and other publications.

W4PFQ — Allen (Al) P. Haase, needed a combination audio preamplifier, with automatic gain control, voice-controlled break-in circuit, and phone patch. The result, after many hours of construction and testing, is the **OMNIVOX** described in this issue on pages 1 to 6.

Al's fine station is shown on page 1. The transmitter is completely home constructed, including the exciter unit at the right.

W4PFQ is Manager of Advanced Development Engineering for General Electric's Receiving Tube Department in Owensboro. He and his staff are busily engaged in developing exotic new thermionic devices like **TIMMS** circuits, the tiny high-temperature, radiation-resistant packaged electronics circuits described on page 2 of the July-August, 1959 issue.



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